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(54) Abstract Title
Creating, managing and distributing learning assets.

(57) A content object for a learning module, course or programme is produced by: providing a repository of media objects (such as text, graphics, video sequences and audio sequences) and metadata for each media object; selecting a plurality of the media objects and their metadata from the repository; producing metadata for the selection of media objects; and assembling the selected media objects, the metadata for each selected media object and the metadata for the selection of media objects to produce the content object. A learning object may then be produced by: selecting a plurality of such content objects; producing metadata for the selection of content objects; and assembling the selected content objects and the metadata for the selection of content objects to produce the learning object. The learning object has a single assessable outcome, and is delivered in a form complying with a predefined standard or specification. Methods, processes and tools for enabling the above are described.

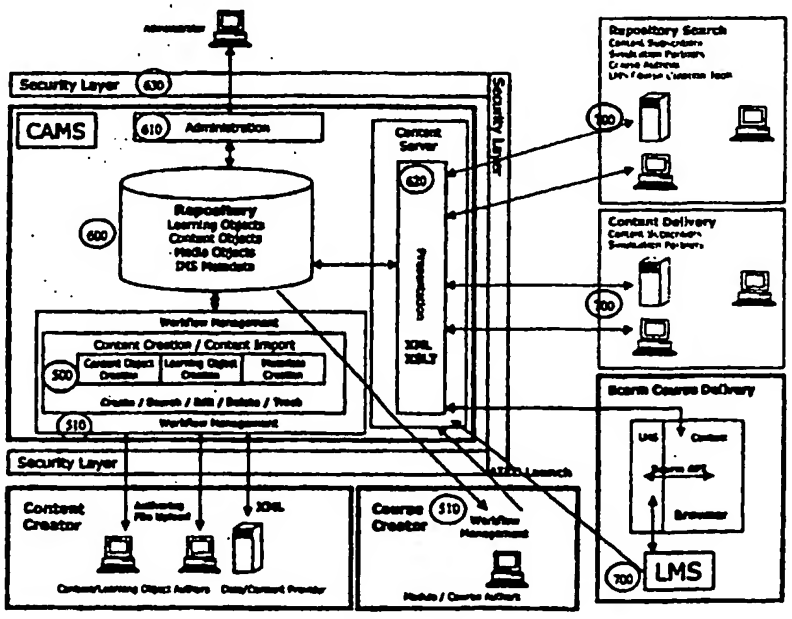

FIG. 2

GB 2 373 625 A

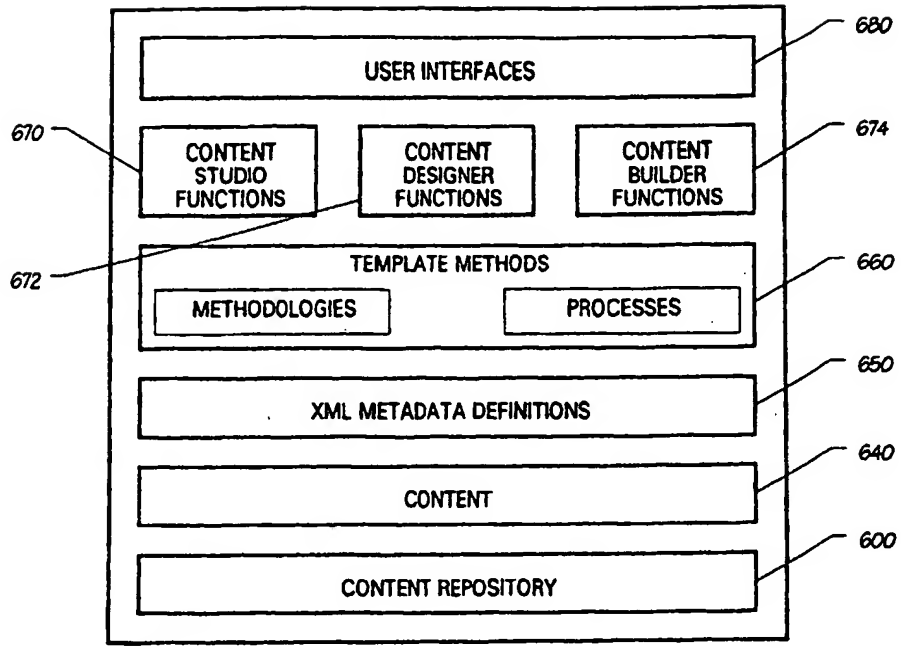
USER INTERFACES
680
670
CONTENT STUDIO FUNCTIONS
CONTENT DESIGNER FUNCTIONS
CONTENT BUILDER FUNCTIONS
674
672
TEMPLATE METHODS
METHODOLOGIES
PROCESSES
660
650
XML METADATA DEFINITIONS
640
CONTENT
600
CONTENT REPOSITORY

FIG. 1

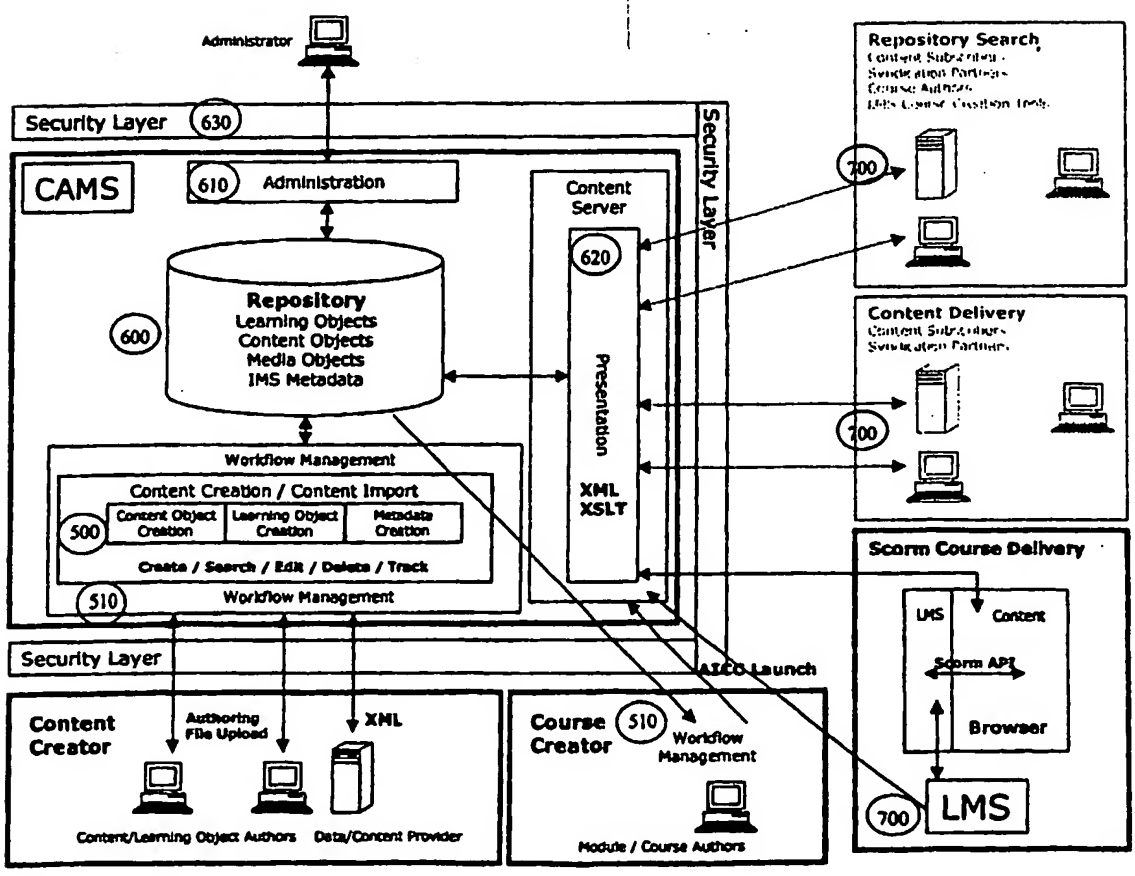
Administrator
Security Layer
630
CAMS
610
Administration
Repository
Learning Objects
Content Objects
Media Objects
IMS Metadata
600
Workflow Management
Content Creation / Content Import
Content Object Creation
Learning Object Creation
Metadata Creation
500
Create / Search / Edit / Delete / Track
510
Workflow Management
Content Server
620
Presentation
XML
XSLT
Security Layer
Repository Search
700
Content Delivery
700
Scorm Course Delivery
LMS
Content
Scorm API
Browser
700
LMS
AICC Launch
Content Creator
Authoring File Upload
XML
Content/Learning Object Authors
Data/Content Provider
Course Creator
510
Workflow Management
Module / Course Authors

FIG. 2

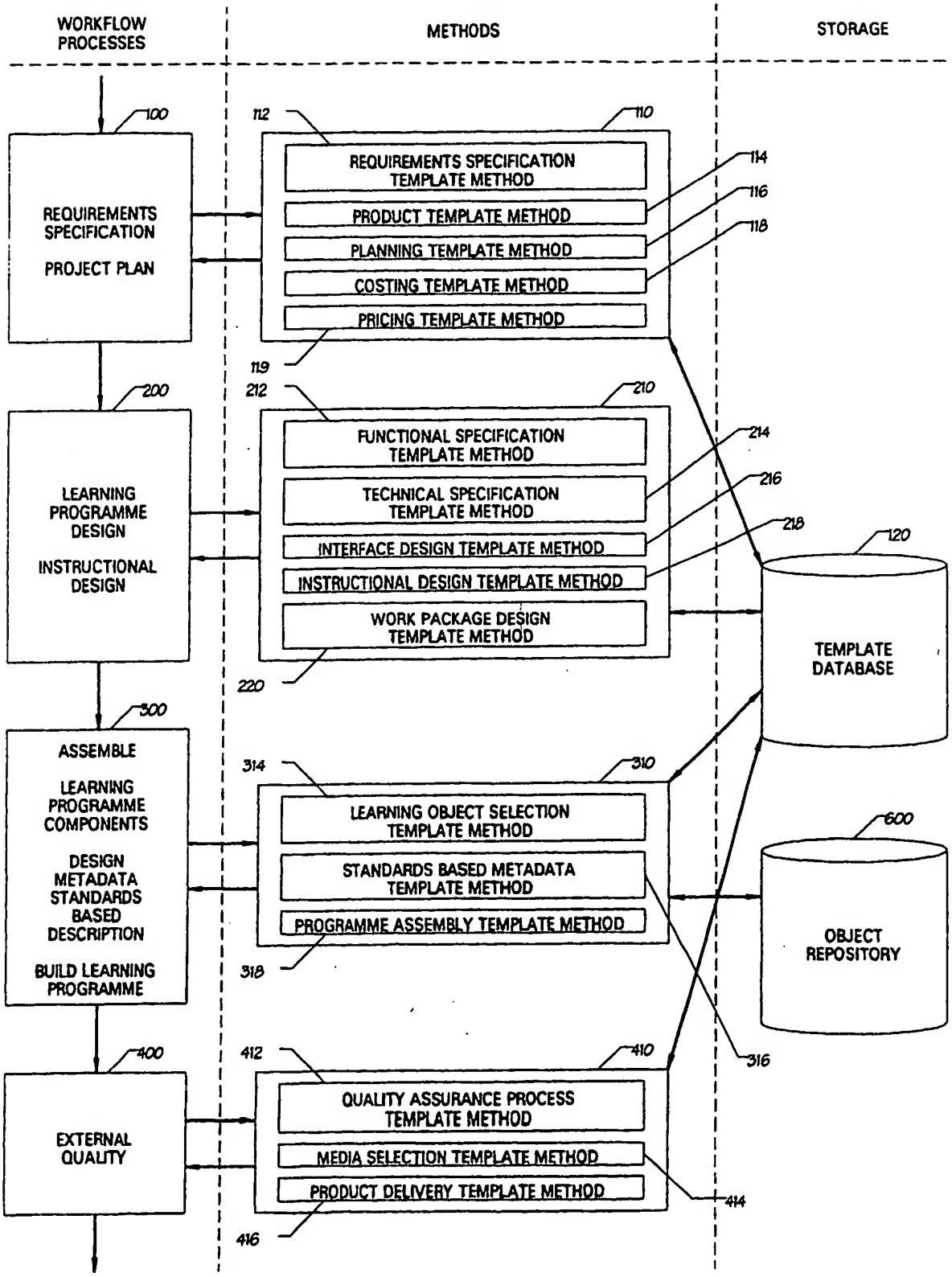
WORKFLOW PROCESSES
METHODS
STORAGE
100
REQUIREMENTS SPECIFICATION
PROJECT PLAN
112
110
REQUIREMENTS SPECIFICATION TEMPLATE METHOD
PRODUCT TEMPLATE METHOD
PLANNING TEMPLATE METHOD
COSTING TEMPLATE METHOD
PRICING TEMPLATE METHOD
114
116
118
119
200
LEARNING PROGRAMME DESIGN
INSTRUCTIONAL DESIGN
212
210
FUNCTIONAL SPECIFICATION TEMPLATE METHOD
TECHNICAL SPECIFICATION TEMPLATE METHOD
INTERFACE DESIGN TEMPLATE METHOD
INSTRUCTIONAL DESIGN TEMPLATE METHOD
WORK PACKAGE DESIGN TEMPLATE METHOD
214
216
218
220
120
TEMPLATE DATABASE
300
ASSEMBLE
LEARNING PROGRAMME COMPONENTS
DESIGN METADATA STANDARDS BASED DESCRIPTION
BUILD LEARNING PROGRAMME
314
310
LEARNING OBJECT SELECTION TEMPLATE METHOD
STANDARDS BASED METADATA TEMPLATE METHOD
PROGRAMME ASSEMBLY TEMPLATE METHOD
318
600
OBJECT REPOSITORY
316
400
EXTERNAL QUALITY
412
410
QUALITY ASSURANCE PROCESS TEMPLATE METHOD
MEDIA SELECTION TEMPLATE METHOD
PRODUCT DELIVERY TEMPLATE METHOD
414
416

FIG. 3

TITLE

Creating, Managing And Distributing Learning Assets

DESCRIPTION

This invention lies in the field of technology-enabled learning.

Training material once produced solely as paper workbooks can now be made available as multimedia productions on a CD ROM and via networks. The Internet has provided the opportunity for the delivery of learning materials directly onto the desktop in the workplace.

In known methods of digital learning material design the process is largely carried out using proprietary authoring tools that do not allow modules and courses designed in one environment to be easily transferred to run with material designed in another. Additionally, these materials, once developed, require highly technical skills and significant effort to modify and change.

Emerging international standards are designed to encourage the development of reusable, interoperable learning materials. The main underlying concept is that of the 'learning object' (a small amount of learning that has a single assessable outcome) and its use as a component in the construction of learning programmes. Modules of learning materials produced using proprietary authoring tools do not currently comply with the emerging standards for interoperability. They can be made compliant by encapsulating them in metadata, and some tools are emerging for this purpose.

Despite the development of standards for interoperability, there is no way to define and manipulate highly granular content from the level of individual media objects upwards.

An aim of this invention, or at least specific embodiments of it, is to allow non-technical people to more easily create, assemble and deploy digital learning material.

One aspect of this invention provides a set of tools and methods to construct learning objects from which learning programmes can be built. The set of tools may be used to specify, design, build, store and deliver learning programmes constructed from learning objects, or to deliver the learning objects themselves. A set of functions may be employed that form a learning content asset management system. These functions allow the user to convert non-digital learning materials into digital form, to design digital learning material in the form of learning

objects, to store, retrieve and manage learning objects and their components from one or more repositories and to deliver the learning programmes in a specific set of output formats to paper, on CD ROM, to the Internet, to PCs and handheld devices.

The invention may utilise emerging technical specifications and standards and emerging XML technology to provide an environment, processes and tools that allow the innovative manipulation of highly granular digital media and its assembly into coherent learning material.

An advantage of the invention, or at least specific embodiments of it, is that, by building learning objects from component parts, learning content authors, instructional designers and other users are able to provide greater flexibility and personalisation for the users of the learning content.

Media objects are the basic elements of the learning materials and are formed from text, graphics, images, video sequences, audio sequences or any other base media types. Methods to capture text, graphics, images, video sequences and audio sequences in the form of media objects, and assemble them into meaningful content objects may form part of the invention. Media objects can be represented using XML structures or other structures that include a description of the media and are stored in media object repositories. The repositories can be searched for appropriate media objects when designing new learning content objects. Content objects represent a coherent learning step in a specified learning experience. Content objects may be combined to form learning objects with an assessable outcome. Complete learning programmes may be formed from a combination of one or more learning objects to form a coherent learning experience.

Learning objects, content objects and media objects can be described by metadata at their different levels. Metadata can be used to describe all the characteristics of the learning material and the learning experience obtainable using the material in specified ways. Methods of combining learning content based on the use of metadata associated with each class of object provide a considerable degree of flexibility in the construction of learning programmes.

The functionality of the methods may be based on the use of templates that structure the information flow between the user and the workflow system that embodies the production processes for generating learning objects and learning programmes. Template methods may be used for each step in the process. Template methods drive the interface with the user and convert data and information to a form that can be used by the production system. Templates also receive information from the workflow system and convert it to a form to present at the

user interface. By the use of templates the whole workflow can be structured and quality managed in terms of the information and data need to ensure a quality product is generated.

Another aspect of the invention provides an architecture and methods for the population of a repository of objects with objects and associated metadata. These methods and architecture may include:

- population of a repository of objects with media objects and associated metadata using structured content creation and assembly processes;
- assembly of the media objects into larger content and learning objects using particular methods;
- assembly of content and learning objects into modules, courses and learning programmes using particular methods; and
- delivery of the learning content to a learning management system in a form complying with AICC and IEEE/IMS or other pre-defined specifications and standards. Alternatively, delivery to syndication partners, content subscribers, course authors, or other delivery devices in open standards forms and protocols such as WML, and to proprietary systems through the use of, for example, XML and XSLT transformation.

Another aspect of the invention provides a method of template-based specification of the processes of designing, building, storing and delivering learning programmes constructed from learning objects.

A specific embodiment of the present invention will now be described, purely by way of example, with reference to the accompanying drawings, in which:

Fig. 1 represents an overview of, and the relationship between, the logical components of an embodiment of the invention;

Fig. 2 represents an overview of the general technical architecture of the embodiment of the invention; and

Fig. 3 is a description of the functions contained in each class of methods used in the embodiment of the invention.

Referring to Fig. 1, the logical components of the embodiment of the invention can be represented as comprising:

- a content repository 600, which is a structured data store;
- content 640;

- XML metadata definitions 650;
- template methods 660 describing methodologies and processes;
- content functions 670-674, including:
  - content studio functions 670 that provide methods for conversion of existing learning content to a form that is compliant with the IEEE/IMS metadata standard;
  - content designer functions 672 that provide methods for specifying and designing media objects, content objects and learning objects, and for managing their storage; and
  - content builder functions 674 that provide methods for constructing modules, courses and learning programmes from learning objects to create flexible and tailored courseware; and
- user interfaces 680.

Novelty in the embodiment of the invention resides mainly in the XML metadata definitions 650, the template methods 660 and the content functions 670-674.

Referring now to Fig. 2, a particular part of the system (the "Content Asset Management System") provides architecture and methods for the population of the hardware and software repository 600 of objects with media objects and associated metadata.

The objects are placed into the repository 600 through structured content creation and content assembly processes 510. These processes are defined by a series of particular methods (the "Content Studio Methods") 100-410 as will be described below with reference to Fig. 3 and a set of structured workflow management processes 520. Once the objects are placed within the repository they can be assembled into larger content and learning objects using the Content Studio Methods 510. These, in turn can be assembled into modules, courses and learning programmes using the Content Studio Methods 510.

All data must pass through a security layer 630 as it enters or leaves the content asset management system environment. The security layer also protects the integrity of the administration system and functions 610. The Administration system allows designated administrators to set access permissions for users of the system, and to define attributes for specific media.

The learning content 620 is delivered from the content asset management repository through a content server that is defined and structured in XML format. Objects within the

repository do not have presentation or navigation attributes, these are added by the XML/XSLT presentation layer within the content server at run-time.

The learning content is delivered to a learning management system 700 in a form complying with AICC and IEEE/IMS specifications and standards. It can also be delivered to syndication partners, content subscribers, course authors, or other delivery devices 700 in open standards forms and protocols such as WML, and to proprietary systems through the use of XML and XSLT transformation.

Referring now to Fig. 3, the Content Studio Methods provide for the conversion of existing digital learning material into IEEE/IMS standards compliant form or other defined form. At the outset of the production process Fig.3 100 it is necessary to capture the specification of the requirements of the learning programme and define a project plan. The requirements specification is drawn up using a defined set of processes 110 driven by the templates for specification of requirements. The requirements specification template is stored in the template database 120. The template is used by the requirements specification process method 112 in the process of obtaining information from the client about the learning material to be converted to a standards compliant form.

Information obtained from the specification process 112 is used to populate the product templates 114 in the definition of the product. The information will be used later in the processing to design the metadata used to describe the product and its component parts. The conversion process has a number of well-defined steps and these are represented in the planning template method 116. The planning template method is used by the planning processes to plan the whole project in terms of the resources required for all stages of design. These processes are controlled by an embedded workflow system 100, 200, 300, 400. A costing template method 118 is used to set a price for the conversion of the learning material. The costing process 118 is driven by the pricing template method 119 and makes use of information already obtained during the specification and design processes.

The design of the learning programme process 200 is concerned with the definition of the functional specification and the technical specification of the learning programme modules. To drive this processing the functional specification template method 212 is obtained from the template database 120. Similarly the technical specification template method 214 is used to drive the processing to define the technical specification. An important part of the design of a learning experience is the definition of the interaction between the learner and the learning programme. The definition of the interface is obtained using the interface design template method 216 for

each learning module. The task of instructional design 200 is an essential part of the design to transform a specification of learning in terms of required outcomes into a coherent learning experience. This is especially true when constructing learning programmes from a number of modules drawn from different sources. Instructional design template methods and workflow processes 200 drive the processing and the interface with the instructional design specialists, using information obtained in the specification processing tasks. The conversion process for the learning material can then be defined in terms of a number of structured workflow tasks that can be assigned to resources for production and assembly. Using the work package design template method 220 the designer is able to use information obtained by the specification and instructional design processes 200 to structure the design into packages.

Once the learning objects have been designed they can be stored in the repository 600 for use later in constructing learning programmes. Each learning object will have associated with it a number of metadata items defined by the IEEE/IMS or other metadata specification or standards body with additional customised metadata as required. Using the metadata template method 316 the designer is able to derive the correct metadata from previously defined information and from new information about the product entered during the learning programme assembly process 300. Some items of metadata can be entered automatically others will require an interaction with the designer.

To build a learning programme from the learning objects that have been either derived from the existing learning modules or designed as part of another process the programme assembly template methods 318 are selected from the template database 120 using the learning object template method 314. These templates drive the programme building processes 300 allowing the learning programme designer to select learning objects from the learning object repository 600 according to the specification constructed earlier. The programme assembly template methods 318 make use of the metadata describing the learning objects and the specification of the learning programme. In the process of construction checks are carried out on the pre-requisites and post-processing requirements of each learning object selected. These steps are a necessary part of the processing to ensure the coherence of the overall programme.

The whole programme is subject to an external quality assurance process 400 as well as an internal process. The quality assurance processing is carried out using the quality assurance template methods 412. The designer uses them to complete automated and semi-automated checks on the assembled programme. The delivery of the learning programme to the client requires the programme to be constructed to meet the requirements of the specified delivery

channels. Packaging of the learning programme makes use of the processing associated with the media selection template method 414. The delivery of the standards-based learning programme includes hand-over procedures. Processing of these stages is carried out in accordance with the product delivery template method 416.

There follows a glossary of some of the terms used in this specification:

AICC: Aviation Industry CBT Committee. An international association of technology-based training professionals. The AICC develops guidelines for aviation industry in the development, delivery, and evaluation of CBT and related training technologies.(http://www.aicc.org/).

IEEE/IMS: IEEE: The Institute of Electrical and Electronics Engineers (http://www.ieee.org).
IMS: IMS Global Learning Consortium is developing and promoting open specifications for facilitating online distributed learning activities. (http://www.imsproject.org).

metadata: Metadata is machine understandable descriptive information about information.(http://www.w3.org/Metadata/).

WML: Wireless Application defines an open industry standard for developing applications over wireless communication networks. (http://www.wapforum.org).

XML: Extensible Markup Language is a universal format for structured documents and data on the World Wide Web. (http://www.w3.org/XML/).

XSLT: XSLT is a language for transforming XML documents into other XML documents.(http://www.w3.org/TR/xslt).

It should be noted that the embodiment of the invention has been described above purely by way of example and that many modifications and developments may be made thereto within the scope of the present invention.

CLAIMS

1. A method of producing a content object for a learning module, course or programme, comprising the steps of:

providing a repository of media objects and metadata for each media object;

selecting a plurality of the media objects and their metadata from the repository;

producing metadata for the selection of media objects; and

assembling the selected media objects, the metadata for each selected media object and the metadata for the selection of media objects to produce the content object.

2. A method of production of a learning object for a learning module, course or programme, comprising the steps of:

selecting a plurality of content objects produced by the method of claim 1;

producing metadata for the selection of content objects; and

assembling the selected content objects and the metadata for the selection of content objects to produce the learning object.

3. A method as claimed in claim 2, wherein the learning object has a single assessable outcome.

4. A method as claimed in claim 3, further including the step of delivering the learning object in a form complying with a predefined standard or specification.